

What is claimed is:

- 1) **A coal-based cellular product comprising a matrix of cells having integral stiffeners or load paths, directed heat transfer paths and/or directed mass transfer paths defined in said matrix by cells of a different density or of a different size.**
- 2) **The coal-based cellular product of claim 1 prepared from bituminous coal.**
- 3) **The coal-based cellular product of claim 2 wherein said bituminous coal has a swell index of between about 3 and about 5.**
- 4) **The coal-based cellular product of claim 2 wherein said bituminous coal has a Gieseler plasticity value above about 500DDPM.**
- 5) **The coal-based cellular product of claim 1 wherein said stiffeners or load paths, directed heat transfer paths and/or directed mass transfer paths are due to the presence of coal-based cells of a structure differing from those comprising the matrix.**
- 6) **The coal-based cellular product of claim 1 wherein said stiffeners or load paths, directed heat transfer paths and/or directed mass transfer**

paths are due to the presence of coal-based cells of different densities than those comprising the matrix.

- 7) The coal-based product of claim 3 wherein said stiffeners or load paths, and mass transfer paths are defined by the presence of coal-based structure of higher density or greater cell wall thickness than that of the surrounding matrix.

- 8) A method for the production of a coal-based cellular product comprising a matrix of cells having integral stiffeners or load paths, directed heat transfer paths and/or directed mass transfer paths defined in or about said matrix by cells of a different density or of a different size said method comprising:

- A) selecting as the matrix material a first coal-based precursor ground to a particle size below about 1mm which matrix material will, upon expansion, provide a matrix of an appropriate strength and density;
- B) selecting a second coal-based precursor ground to a particle size below about 1mm, but of a different particle size than that of said matrix, said second coal-based precursor when expanded providing the required integral stiffener or load paths, heat transfer paths and/or mass transfer paths;

C) loading each of said selected coal-based precursors into each of at least two predefined volumes of a mold separated by appropriate partition(s) to define said matrix of said first coal-based precursor having said integral stiffeners or load paths, directed heat transfer paths and/or mass transfer paths defined by said second coal-based precursor in or about said matrix;

D) heating said mold under a non-oxidizing atmosphere to a temperature of between about 300°C and about 700°C and soaking at this temperature for a period of from about 10 minutes to about 12 hours; and

E) controllably cooling said coal-based product.

9) The method of claim 8 wherein said partitions are removed prior to initiation of said heating.

10) The method of claim 8 wherein said partitions remain in place during said heating and are either integrated into the coal-based product or vaporized.

11) The method of claim 8 wherein said mold comprises glass or ceramic.

12) A method for the production of a coal-based cellular product comprising a matrix of cells having integral stiffeners or load paths,

*thermal insulating
rapid heat up
volatiles removed from top or outer surface
before interior
dense skin outside
less dense core*

directed heat transfer paths and/or directed mass transfer paths defined
by or about said matrix by cells of a different density comprising:

- A) placing a coal-based precursor ground to a particle size below
about 1mm into a thermally conductive mold;
- B) placing said mold into a pressure chamber under a non-
oxidizing atmosphere;
- C) heating said mold at a rapid heat-up rate to a temperature of
between about 300°C and about 700°C and soaking at this
temperature for a period of from about 10 minutes to about 12
hours; and
- D) controllably cooling said coal-based product
to provide a product comprising a relatively less dense coal-based
cellular core surrounded by a relatively more dense and therefore
less permeable skin.

13) The method of claim 12 wherein said mold comprises aluminum or

rapid heat up
Top p14
steel.
thermal conductive
enter side devolatilization
cokes + porosity
inside